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EXAMINER

CRUTCHFIELD, CHRISTOPHER M

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/511,613

Applicant(s)

HALL ET AL.

Examiner

Christopher Crutchfield

Art Unit

2466

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 August 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 and 19-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 and 19-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/GS/US)
Paper No(s)/Mail Date _____

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. **Claims 1-4 and 10-15** are rejected under 35 U.S.C. 102(e) as being rejected under 35 U.S.C. 103(a) as being unpatentable over *Uzun*, et al. (US Patent No. 6,961,342 B1) in view of *Reeve*, et al. (US Pre Grant Publication No. 2002/0027902).

Regarding claim 1, *Uzun* discloses a packet switch:

- a. Having plural input sectors (Fig. 4, Elements 410a-c) and output sectors, (Fig. 4, Elements 420a-c) each input sector being arranged to hold at least one queue per

output sector, (Fig. 5, IVOQ 0 to K-1) each output sector having plural output ports (Fig. 4, Element 470) and being arranged to hold at least one queue per output port (Fig. 4, Element 422). (The system of *Uzun* discloses a switch that utilizes multiple input sectors connected to multiple output sectors via several parallel links and a central switch fabric [Fig. 4 and Column 12, Lines 44-64]. The input sectors each contain multiple virtual output queues into which the data received from each input in the sector is placed [Fig. 4 and Column 12, Lines 44-64]. The Output Queues may be arranged in one of two ways. First, a shared virtual output queue may be created for each output port of each output group [i.e. all output ports] [Fig. 5 and Column 13, Lines 7-16]. Second, to simplify scheduling by reducing the number of VOQ's and to enhance multicasting, a single VOQ for each output sector may be utilized [Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50]. Turning to the output sectors, each output sector may likewise hold a single output queue for each output port [Fig. 4, Element 422 and 470 and Column 12, Lines 44-64].)

b. Wherein the input sectors are connected to the output sectors via links configured to afford speed-up of data transfer, wherein the links comprise a set of links (Fig. 4, Elements 0 to M-1 and Column 9, Line 37, Column 15, Lines 15-17, Column 19, Lines 9-32, Column 32, Lines 32-38). (The system of *Uzun* discloses that each input sector comprises a number of links to the output sector, [Fig. 4, Element 440] and that speedup may be implemented Such that the bandwidth out of the Input Shared Block Exceeds the bandwidth of the individual inputs [Fig. 4, Elements 0 to M-1 and Column 9, Line 37, Column 15, Lines 15-17, Column 19, Lines 9-32, Column 32, Lines 32-38].)

c. Wherein the switch has means for cyclically connecting different subsets of the set of links between the input sectors and the output sectors, and means responsive to statistical variations in traffic applied to input ports of said input sectors to vary the set of links (Column 14, Line 57 to Column 15, Line 5). (The system of *Uzun* implements Round Robin connection of each Virtual Output Group. This results in the cyclic connection of each VOQ to the corresponding Output Shared block. The round robin scheduling is capable of altering the cyclic pattern to allow an Output Group to transmit twice if another output group is idle [Column 14, Line 57 to Column 15, Line 5]. Round robin scheduling can be applied on a per group VOQ basis or a per output VOQ basis, depending on the type of output queuing in use [Column 14, Line 5 to Column 15, Line 5].)

Uzun fails to disclose a packet switch for switching packets, carried in timeslots, between traffic sources and traffic sinks wherein the switch has means for cyclically connecting different subsets of the set of links between the input sectors and the output sectors to allow transfer of packets according to elements that specify the time averaged required capacity between each traffic source – traffic sink pair, wherein the set of links is varied in accordance with variations in the time averaged capacity and not at a time slot rate. In the same field of endeavor, *Reeve* discloses a packet switch for switching packets, carried in timeslots, between traffic sources and traffic sinks wherein the switch has means for cyclically connecting different subsets of the set of links between the input sectors and the output sectors to allow transfer of packets according to with elements that specify the time averaged required capacity between each traffic source – traffic sink pair, wherein the set of links is varied in accordance with variations in the time averaged capacity and not at a time slot rate (Paragraphs 0012-0021 and

0061-0095 and Figs 1, 3, and 4). (The system of *Reeve* discloses a system which maintains separate VOQ's at each ingress port [Fig. 1, Element 102]. The system of *Reeve* further discloses that the system schedules packet transmission in timeslots by creating a desired load matrix/rate matrix which may reflect the desired average traffic rate between each ingress [i.e. traffic source] and egress [i.e. traffic sink] queue [Paragraphs 0040 and 0074]. The rate matrix is then de-composed into a series of service matrices/configuration matrices which dictate the connection of the input and output ports for a particular timeslot and have rows and columns that add up to the total bandwidth on each of the internal links [Paragraphs 0060 to 0061]. The values contained in each rate matrix are integer values of 0 and 1 and are in units of the link rate, each corresponding to the transmission of a packet at the internal link rate for the timeslot. The system then implements the permutations to achieve the desired average bandwidth allocation between the source and sink ports [Paragraphs 0073-0095].)

Therefore, since *Reeves* discloses a system that assigns bandwidth by creating a series of connections between input and output ports at the timeslot rate such that the time average transmission rate over a series of the connections approaches the average rate specified for each traffic source/input and traffic sink/output pair, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the time averaged source sing connections of *Reeves* into the system of *Uzun* by connecting the data source/input and data sink/output ports according to a series of timeslot based connection patterns that approach the specified average transmission rate for each data source/data sink pair. The motive to combine is to reduce scheduling complexity by considering scheduling only in a series of connection patters which result in the desired traffic transmission rates for each data source and data sink pair.

Uzun as modified by *Reeves* fails to disclose that the configured rates for each data source/data sink pair are stored in a matrix. However, it is officially noted that it was well known in the art at the time of the invention to use a matrix to store data in order to provide a simple construct for accessing related data elements. Therefore, it would have been obvious to a person of ordinary skill in the art at the time to arrange the average data rates for each data source/data sink pair in a matrix.

Regarding claim 2, *Uzun* discloses a packet switch wherein each input sector is arranged to hold one queue per output of the output sectors to provide virtual output queuing (VOQ) (Fig. 5 and Column 13, Lines 7-16). (A shared virtual output queue may be created for each output port of each output group [i.e. all output ports] [Fig. 5 and Column 13, Lines 7-16] [See also Claim 1, *Supra*].)

Regarding claim 3, *Uzun* discloses a packet switch wherein each input sector is arranged to hold only one queue per output sector (Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50). (A single VOQ for each output sector may be utilized [Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50] [See also Claim 1, *Supra*].)

Regarding claim 4, *Uzun* discloses a packet switch having:

- a. Plural input sectors (Fig. 4, elements 410a-c) and output sectors (Fig. 4, Elements 420a-c).
- b. Each input sector having an input sector memory (Fig. 5, Element 412) and plural input ports, (Fig. 5, Elements jM to $jM+M-1$) each port being arranged to receive packet data, the input sector memory being arranged to store plural input queues of packet data from said input ports, at least one said input queue corresponding to each respective

output sector, the input sector memory having a respective output for each said input queue (Fig. 5, elements J_m to J_m+M-1). (The system of *Uzun* discloses a switch that utilizes multiple input sectors connected to multiple output sectors via several parallel links and a central switch fabric [Fig. 4 and Column 12, Lines 44-64]. The input sectors each contain multiple virtual output queues into which the data received from each input in the sector is placed [Fig. 4 and Column 12, Lines 44-64]. The Output Queues may be arranged in one of two ways. First, a shared virtual output queue may be created for each output port of each output group [i.e. all output ports] [Fig. 5 and Column 13, Lines 7-16]. Second, to simplify scheduling by reducing the number of VOQ's and to enhance multicasting, a single VOQ for each output sector may be utilized [Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50].)

c. Each output sector having an output sector memory and plural output ports, the output sector memory being arranged to store plural output queues and having plural inputs for packet data and being arranged to pass packet data to a respective output port (Fig. 4, Element 422 and 470 and Column 12, Lines 44-64). (The output sectors of *Uzun* may hold a single output queue for each output port [Fig. 4, Element 422 and 470 and Column 12, Lines 44-64].)

d. The packet switch further having a population of links (Fig. 4. Element 440) and a control device (Column 19, Lines 9-32).

e. Wherein said population comprises plural links for carrying packet data between outputs of the input sector memory and inputs of the output sector memory (Fig. 4. Element 440 - See Also (b), *Supra*).

f. Wherein the control device is operable to form a selection of links from said population to provide speed-up, and thereby enable packet data transfer between said outputs and inputs using said selection of links and the control device being further operable to vary said selection to cope with changing traffic conditions (Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38). (The system of *Uzun* may implement multiple round robin queuing. In such a queuing architecture, a single GVOQ queue may be allocated multiple transmission links in order to provide a link speedup to handle excessive traffic bound for a particular GVOQ [Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38]. The extra link may come from robbing another GVOQ of the opportunity to transmit, or from an extra link provided by an internal speedup in the switch [Column 32, Lines 34-38].)

Uzun fails to disclose a packet switch having plural input sectors and output sectors, each input sector having an input sector memory and plural input ports, each port being arranged to receive packet data, carried in time slots, between traffic sources and traffic sinks wherein said population comprises plural links for carrying packet data between outputs of the input sector memory and inputs of the output sector memory, and wherein the control device is operable to form a selection of links from said population to provide speed-up, and thereby enable packet data transfer between said outputs and inputs using said selection of links to allow transfer of packets according to elements that specify the time-average required capacity

between each traffic source - traffic sink pair. In the same field of endeavor, *Reeve* discloses a packet switch having plural input sectors and output sectors, each input sector having an input sector memory and plural input ports, each port being arranged to receive packet data, carried in time slots, between traffic sources and traffic sinks wherein said population comprises plural links for carrying packet data between outputs of the input sector memory and inputs of the output sector memory, and wherein the control device is operable to form a selection of links from said population to provide speed-up, and thereby enable packet data transfer between said outputs and inputs using said selection of links to allow transfer of packets according to elements that specify the time-average required capacity between each traffic source - traffic sink pair (Paragraphs 0012-0021 and 0061-0095 and Figs 1, 3, and 4). (The system of *Reeve* discloses a system which maintains separate VOQ's at each ingress port [Fig. 1, Element 102]. The system of *Reeve* further discloses that the system schedules packet transmission in timeslots by creating a desired load matrix/rate matrix which may reflect the desired average traffic rate between each ingress [i.e. traffic source] and egress [i.e. traffic sink] queue [Paragraphs 0040 and 0074]. The rate matrix is then de-composed into a series of service matrices/configuration matrices which dictate the connection of the input and output ports for a particular timeslot and have rows and columns that add up to the total bandwidth on each of the internal links [Paragraphs 0060 to 0061]. The values contained in each rate matrix are integer values of 0 and 1 and are in units of the link rate, each corresponding to the transmission of a packet at the internal link rate for the timeslot. The system then implements the permutations to achieve the desired average bandwidth allocation between the source and sink ports [Paragraphs 0073-0095].)

Therefore, since *Reeves* discloses a system that assigns bandwidth by creating a series of connections between input and output ports at the timeslot rate such that the time average

transmission rate over a series of the connections approaches the average rate specified for each traffic source/input and traffic sink/output pair, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the time averaged source sing connections of *Reeves* into the system of *Uzun* by connecting the data source/input and data sink/output ports according to a series of timeslot based connection patterns that approach the specified average transmission rate for each data source/data sink pair. The motive to combine is to reduce scheduling complexity by considering scheduling only in a series of connection patters which result in the desired traffic transmission rates for each data source and data sink pair.

Uzun as modified by *Reeves* fails to disclose that the configured rates for each data source/data sink pair are stored in a matrix. However, it is officially noted that it was well known in the art at the time of the invention to use a matrix to store data in order to provide a simple construct for accessing related data elements. Therefore, it would have been obvious to a person of ordinary skill in the art at the time to arrange the average data rates for each data source/data sink pair in a matrix.

Regarding claim 10, *Uzun* discloses a packet switch wherein each link has a similar packet rate to the line rate of packet flow at switch input ports (Column 9, Lines 27-40 and Fig. 4). (Each module/sector has the same number of inputs and outputs [Column 9, Lines 27-40 and Fig.]. Furthermore, the central switch operates with out speedup [i.e. at the combined line rate of all the inputs] and all the module output links operate at the same speed [Column 13, Lines 42-47]. Therefore, the sum of the bandwidth of the module output links equals the control switch bandwidth which equals the sum of the bandwidths of the input ports. Since the number of input ports and module output links are the same, their bandwidth must likewise be equal as well.)

Regarding claim 11, *Uzun* discloses a packet switch which comprises multiple input and output sectors wherein the input sectors contain individual virtual output queues.

Uzun fails to fails to disclose a packet switch wherein the control device comprises a processor constructed and arranged to construct a service matrix having integer entries in units of the link rate and having row and column sums equal to the number of input ports from each input sector and ports of each output sector said plurality such that in said units of the internal link rate, each of said integer entries exceeds the corresponding entry in a desired traffic matrix, said matrix having elements formed by the said desired offered load at the switch inputs on the basis of each input and output port; and to decompose the service matrix into its constituent permutations thereby to control said links using said permutations. In the same field of endeavor, *Reeve* discloses a packet switch wherein the control device comprises a processor constructed and arranged to construct a service matrix having integer entries in units of the link rate and having row and column sums equal to the number of input ports from each input sector and ports of each output sector such that in said units of the internal link rate, each of said integer entries exceeds the corresponding entry in a desired traffic matrix, said matrix having elements formed by the said desired offered load at the switch inputs on the basis of each input and output port; and to decompose the service matrix into its constituent permutations thereby to control said links using said permutations (Paragraphs 0012-0021 and 0061-0095 and Figs 1, 3, and 4). (The system of *Reeve* discloses a system which maintains separate VOQ's at each ingress port [Fig. 1, Element 102]. The system of *Reeve* further discloses that the system schedules packet transmission by creating a desired load matrix/rate matrix [Paragraphs 0040 and 0074]. The rate matrix is then de-composed into a series of service matrices/configuration matrices which have rows and columns that add up to the total bandwidth on the links [Paragraphs 0060 to 0061]. The values contained in each rate matrix are integer values of 0 and

1 and are in units of the link rate, each corresponding to the transmission of a packet at the internal link rate. The system then implements the permutations to achieve the desire bandwidth allocation [Paragraphs 0073-0095].)

Therefore, since *Reeve* discloses the use of per port VOQs and the use of a service matrix, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the VOQs and Service Matrices of *Reeve* into the teachings of *Uzun*. The VOQs and Service Matrices of *Reeve* can be combined with the system of *Uzun* by implementing a separate VOQ for each input at each input sector to promote fairness among the input queues and to then schedule among the inputs and outputs using the rate matrix and service matrices as taught by *Reeve*. The motive to combine is to utilize separate queues at each input to promote fairness and to utilize a simple matrix decomposition scheduling algorithm capable of operating at high speed.

Regarding claim 12, *Uzun* discloses a method of routing packets in a packet switch having plural input sectors and output sectors, each input sector being arranged to hold at least one queue per output sector, each output sector having plural output ports and being arranged to hold at least one queue per output port (Figs. 4 and 5 - See Claim 4, *Supra*) the method comprising:

- a. Providing a set of links for connecting each input sector queue to respective output sector queues (Fig. 4, Element 440). (The system of *Uzun* discloses a switch that utilizes multiple input sectors connected to multiple output sectors via several parallel links and a central switch fabric [Fig. 4 and Column 12, Lines 44-64]. The input sectors each contain multiple virtual output queues into which the data received from each input in the sector is placed [Fig. 4 and Column 12, Lines 44-64]. Each per to VOQs is connected to

the central switch and the outputs by multiple parallel links [Fig. 4, Element 440]. The Output Queues may be arranged in one of two ways. First, a shared virtual output queue may be created for each output port of each output group [i.e. all output ports] [Fig. 5 and Column 13, Lines 7-16]. Second, to simplify scheduling by reducing the number of VOQ's and to enhance multicasting, a single VOQ for each output sector may be utilized [Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50]. Turning to the output sectors, each output sector may likewise hold a single output queue for each output port [Fig. 4, Element 422 and 470 and Column 12, Lines 44-64].)

b. Connecting at least some input sector queues to respective output sector queues using a subset of said set of links, said subset affording speed-up of data transfer, and cyclically selecting different subsets of the set of links between the input sectors and the output sectors (Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38). (The system of *Uzun* may implement multiple round robin queuing in order to cycle through each subset of links between the different sectors. As long as each VOQ of each sector has data for the appropriate output and does not exceed a danger threshold, the round robin scheduler cyclically transmits the data [Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38]. However, if a VOQ exceeds a predefined threshold, the scheduler will respond by allocating multiple transmission links in order to provide a link speedup to handle excessive traffic bound for a particular GVOQ [Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38]. The extra link may come from robbing another GVOQ of the opportunity to transmit, or from an extra link provided by an internal speedup in the switch [Column 32, Lines 34-38].)

Uzun fails to disclose a method of routing packets transported in time slots between traffic source and traffic sinks, the packet switch being configured to allow transfer of packets according to a matrix with elements that specify the time-average capacity required between each traffic source - traffic sink pair, the method comprising selecting different subsets of the set of links between the input sectors and the output sectors and varying the set of links in accordance with variations in the time-average capacity and not at a time slot rate. In the same field of endeavor, *Reeve* discloses a method of routing packets transported in time slots between traffic source and traffic sinks, the packet switch being configured to allow transfer of packets according to a matrix with elements that specify the time-average capacity required between each traffic source - traffic sink pair, the method comprising selecting different subsets of the set of links between the input sectors and the output sectors and varying the set of links in accordance with variations in the time-average capacity and not at a time slot rate (Paragraphs 0012-0021 and 0061-0095 and Figs 1, 3, and 4). (The system of *Reeve* discloses a system which maintains separate VOQ's at each ingress port [Fig. 1, Element 102]. The system of *Reeve* further discloses that the system schedules packet transmission in timeslots by creating a desired load matrix/rate matrix which may reflect the desired average traffic rate between each ingress [i.e. traffic source] and egress [i.e. traffic sink] queue [Paragraphs 0040 and 0074]. The rate matrix is then de-composed into a series of service matrices/configuration matrices which dictate the connection of the input and output ports for a particular timeslot and have rows and columns that add up to the total bandwidth on each of the internal links [Paragraphs 0060 to 0061]. The values contained in each rate matrix are integer values of 0 and 1 and are in units of the link rate, each corresponding to the transmission of a packet at the internal link rate for the

timeslot. The system then implements the permutations to achieve the desired average bandwidth allocation between the source and sink ports [Paragraphs 0073-0095].)

Therefore, since *Reeves* discloses a system that assigns bandwidth by creating a series of connections between input and output ports at the timeslot rate such that the time average transmission rate over a series of the connections approaches the average rate specified for each traffic source/input and traffic sink/output pair, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the time averaged source sing connections of *Reeves* into the system of *Uzun* by connecting the data source/input and data sink/output ports according to a series of timeslot based connection patterns that approach the specified average transmission rate for each data source/data sink pair. The motive to combine is to reduce scheduling complexity by considering scheduling only in a series of connection patters which result in the desired traffic transmission rates for each data source and data sink pair.

Uzun as modified by *Reeves* fails to disclose that the configured rates for each data source/data sink pair are stored in a matrix. However, it is officially noted that it was well known in the art at the time of the invention to use a matrix to store data in order to provide a simple construct for accessing related data elements. Therefore, it would have been obvious to a person of ordinary skill in the art at the time to arrange the average data rates for each data source/data sink pair in a matrix.

Regarding claim 13, *Uzun* fails to disclose determining the variations in the time average capacity (Paragraphs 0012-0021 and 0061-0095 and Figs 1, 3, and 4). (The system of *Reeve* discloses a system which maintains separate VOQ's at each ingress port [Fig. 1, Element 102]. The system of *Reeve* further discloses that the system schedules packet transmission in timeslots by creating a desired load matrix/rate matrix which may reflect the

desired average traffic rate between each ingress [i.e. traffic source] and egress [i.e. traffic sink] queue [Paragraphs 0040 and 0074]. The rate matrix is then de-composed into a series of service matrices/configuration matrices which dictate the connection of the input and output ports for a particular timeslot and have rows and columns that add up to the total bandwidth on each of the internal links [Paragraphs 0060 to 0061]. The values contained in each rate matrix are integer values of 0 and 1 and are in units of the link rate, each corresponding to the transmission of a packet at the internal link rate for the timeslot. The system then implements the permutations to achieve the desired average bandwidth allocation between the source and sink ports [Paragraphs 0073-0095].)

Therefore, since *Reeves* discloses a system that assigns bandwidth by creating a series of connections between input and output ports at the timeslot rate such that the time average transmission rate over a series of the connections approaches the average rate specified for each traffic source/input and traffic sink/output pair, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the time averaged source sing connections of *Reeves* into the system of *Uzun* by connecting the data source/input and data sink/output ports according to a series of timeslot based connection patterns that approach the specified average transmission rate for each data source/data sink pair. The motive to combine is to reduce scheduling complexity by considering scheduling only in a series of connection patters which result in the desired traffic transmission rates for each data source and data sink pair.

Regarding claim 14, *Uzun* discloses a method wherein the determining step comprises monitoring input queue states (Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38 – See Claim 13, *Supra*).

Regarding claim 15, *Uzun* discloses a method wherein the determining step comprises wherein the determining step comprises monitoring input packet arrivals (Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38). (The system of *Uzun* discloses monitoring the state of each virtual output queue. Whenever a packet arrives it is added to the appropriate VOQ. Therefore monitoring the VOQ monitors input packet arrivals.)

4. **Claims 5-9** are rejected under 35 U.S.C. 103(a) as being unpatentable over *Uzun*, et al. (US Patent No. 6,961,342 B1) and *Reeve*, et al. (US Pre Grant Publication No. 2002/0027902) as applied to claims 4 and 31 and further in view of *Krishna*, et al. (US Pre Grant Publication No. 2001/0050916 A1).

Regarding claim 5, *Uzun* discloses a packet switch wherein each input sector memory is arranged to store one input queue for each output port of the switch (Fig. 4, Element 422 and 470 and Column 12, Lines 44-64). (The output sectors of *Uzun* may hold a single output queue for each output port [Fig. 4, Element 422 and 470 and Column 12, Lines 44-64].)

Uzun fails to disclose a packet switch wherein each input sector memory is arranged to store one input queue per input port of the sector for each output port of the switch. In the same field of endeavor, *Krishna* discloses a packet switch wherein each input sector memory is arranged to store one input queue per input port of the sector for each output port of the switch (Fig. 17 and Paragraphs 0117 and 0119). (The system of *Krishna* discloses input ports that use a separate VOQ for each output port [Fig. 17 and Paragraphs 0117 and 0119] and output ports that use separate queues for each input port.)

Therefore, since *Krishna* discloses the use of separate output ports for each input port, it would have been obvious to a person of ordinary skill in the art at the time of the invention to

implement the per-input port VOQ's of *Krishna* into the switch of *Uzun*. The per-input port VOQs of *Krishna* can be combined with the switch of *Uzun* by implementing a separate per output VOQs for each input port in the switch, as taught by *Krishna* and separately assigning links to each of the VOQs as taught by *Uzun* and *Krishna*. The motive to combine is to promote fairness among inputs in the same sector, by allowing each input to separately contend for access to the selection of links.

Regarding claim 6, *Uzun* discloses a packet switch wherein each output sector memory is arranged to store one output queue per output port of the sector (Fig. 4, Element 422 and 470 and Column 12, Lines 44-64). (The output sectors of *Uzun* may hold a single output queue for each output port [Fig. 4, Element 422 and 470 and Column 12, Lines 44-64].)

Uzun fails to disclose a packet switch wherein each output sector memory is arranged to store one output queue per output port of the sector for each input port of the switch. In the same field of endeavor, *Krishna* discloses a packet switch wherein each output sector memory is arranged to store one output queue per output port of the sector for each input port of the switch (Fig. 17 and Paragraphs 0117 and 0119). (The system of *Krishna* discloses input ports that use a separate VOQ for each output port [Fig. 17 and Paragraphs 0117 and 0119] and output ports that use separate queues for each input port.)

Therefore, since *Krishna* discloses the use of a separate output queue for each input port, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the separate output queues of *Krishna* into the system of *Uzun* by keeping an output queue for each input at each output. The motive to combine is provided by *Krishna* and is to prevent blocking caused by simultaneous attempts to write to each output (Paragraphs 0117 an 0119).

Regarding claim 7, *Uzun* discloses a packet switch as wherein each input sector memory is arranged to store a single output queue per output sector (Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50). (A single VOQ for each output sector may be utilized [Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50] [See also Claim 1, *Supra*].)

Uzun fails to disclose a packet switch wherein each input sector memory is arranged to store a single output queue per output sector for each input port of the switch. In the same field of endeavor, *Krishna* discloses a packet switch wherein each input sector memory is arranged to store a single output queue per output sector for each input port of the switch (Fig. 17 and Paragraphs 0117 and 0119). (The system of *Krishna* discloses a system where each input maintains its own VOQs. The separated VOQs allow each input to separately contend for access to the core switch/selection of links, thereby promoting fair bandwidth allocation among the links [Paragraphs 0071-0077].)

Therefore, since *Krishna* discloses the use of separate input VOQs to promote fair bandwidth allocation among input links, it would have been obvious to a person of ordinary skill in the art at the time of the invention to split the per sector VOQs of the input sector if *Uzun* into separate links that may contend for access to each output link separately because the technique of splitting inputs into separate input queues to promote fairness among the inputs during scheduling contention was part of the ordinary capabilities of a person of ordinary skill in the art, in view of the teaching of the technique for improvement in other situations.

Regarding claim 8, *Uzun* discloses a packet switch as wherein each output sector memory is arranged to store a single output queue per output port of the sector (Fig. 4, Element 422 and 470 and Column 12, Lines 44-64). (The output sectors of *Uzun* may hold a single output queue for each output port [Fig. 4, Element 422 and 470 and Column 12, Lines 44-64].)

Regarding claim 9, *Uzun* fails to disclose a packet switch wherein each link has a higher packet rate than the line rate of packet flow at switch input ports to provide said speed-up. In the same field of endeavor, *Krishna* discloses a packet switch wherein each link has a higher packet rate than the line rate of packet flow at switch input ports to provide said speed-up (Paragraph 0026).

Therefore, since *Uzun* discloses the use of a link speedup, it would have been obvious to implement the link speedup of *Krishna* into the teachings of *Uzun* by increasing the speed of each link in the central switch fabric to exceed the input line rate. The motive to combine is provided by *Krishna* and is to offer a switch fabric that more closely approximates the desirable properties of an output queued switch, where all inputs may transmit to a single output simultaneously (Paragraphs 0016-0020).

5. **Claim 16** is rejected under 35 U.S.C. 103(a) as being unpatentable over *Uzun*, et al. (US Patent No. 6,961,342 B1) and *Reeve*, et al. (US Pre Grant Publication No. 2002/0027902) as applied to claim 12 and further in view of and *Miles*, et al. (US Patent No. 6,665,495 B1).

Regarding claim 16, *Uzun* discloses a packet switch that treats each input sector and output sector as a separate port, but can utilize over speed to allow multiple simultaneous transmissions from a single output sector (Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38). (The system of *Uzun* discloses a switch that utilizes multiple input sectors connected to multiple output sectors via several parallel links and a central switch fabric [Fig. 4 and Column 12, Lines 44-64]. The input sectors each contain multiple virtual output queues into which the data received from each input in the sector is placed [Fig. 4 and Column 12, Lines 44-64]. Each ser to VOQs is connected to the central switch and the outputs by

multiple parallel links [Fig. 4, Element 440]. The Output Queues may contain a single VOQ for each output sector may be utilized [Fig. 5 and Column 8, Lines 47-67 and Column 13, Lines 17-50]. Turning to the output sectors, each output sector may likewise hold a single output queue for each output port [Fig. 4, Element 422 and 470 and Column 12, Lines 44-64]. The system of *Uzun* may implement multiple round robin queuing in order to cycle through each subset of links between the different sectors. As long as each VOQ of each sector has data for the appropriate output and does not exceed a danger threshold, the round robin scheduler cyclically transmits the data [Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38]. However, if a VOQ exceeds a predefined threshold, the scheduler will respond by allocating multiple transmission links in order to provide a link speedup to handle excessive traffic bound for a particular GVOQ [Column 19, Lines 9-32 and Column 30, Lines 34-52 and Column 32, Lines 34-38]. The extra link may come from robbing another GVOQ of the opportunity to transmit, or from an extra link provided by an internal speedup in the switch [Column 32, Lines 34-38].)

Uzun fails to disclose a method wherein the providing step comprises constructing a service matrix having integer entries in units of the internal link rate and having row and column sums equal to the number of ports from each input sector and ports of each output sector such that, in said units of the internal link rate, each of said integer entries exceeds the corresponding entry in a desired traffic matrix, said desired traffic matrix having elements formed by the said desired offered load at the switch input ports on the basis of each input port and output port and decomposing the service matrix into its constituent permutations and controlling said links using said permutations. In the same field of endeavor, *Reeve* discloses a method wherein the providing step comprises constructing a service matrix having integer entries in units of the internal link rate and having row and column sums equal to the number of ports from each input

sector and ports of each output sector such that, in said units of the internal link rate, each of said integer entries exceeds the corresponding entry in a desired traffic matrix, said desired traffic matrix having elements formed by the said desired offered load at the switch input ports on the basis of each input port and output port and decomposing the service matrix into its constituent permutations and controlling said links using said permutations (Paragraphs 0012-0021 and 0061-0095 and Figs 1, 3, and 4). (The system of *Reeve* discloses a system which maintains separate VOQ's at each ingress port [Fig. 1, Element 102]. The system of *Reeve* further discloses that the system schedules packet transmission by creating a desired load matrix/rate matrix [Paragraphs 0040 and 0074]. The rate matrix is then de-composed into a series of service matrices/configuration matrices which have rows and columns that add up to the total bandwidth on the links [Paragraphs 0060 to 0061]. The values contained in each rate matrix are integer values of 0 and 1 and are in units of the link rate, each corresponding to the transmission of a packet at the internal link rate. The system then implements the permutations to achieve the desire bandwidth allocation [Paragraphs 0073-0095].)

Therefore, since *Reeve* discloses scheduling between inputs and outputs using a deconstructed matrices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the matrix deconstruction of *Reeve* into the teachings of *Uzun*. The matrix deconstruction of *Reeve* can be combined with the system of *Uzun* by treating each output sector as a single output, as taught by *Uzun* and implementing matrix decomposition to determine the interconnection of the input and output queues, as taught by *Reeves*, but setting the maximum ingress forwarding rate to the total available link bandwidth (which exceeds 1.0 as stated in *Reeves* because the system of *Uzun* employs a speedup), as taught by *Reeves* and then decomposing the Rate Matrix into the corresponding Traffic Matrices. The motive to combine is to allow for simple scheduling using rate decomposition.

Uzun and *Reeve* fail to disclose that the deconstructed matrices are used cyclically. In the same field of endeavor, *Miles* discloses using a series of deconstructed matrices cyclically (Column 31, Lines 47-67 and Column 33, Lines 10-60). (The system of *Miles* discloses periodically establishing a set of decomposed cyclic matrices that determine the relative bandwidth allocations for each port [Column 31, Lines 47-67 and Column 33, Lines 10-60].) Therefore, since *Miles* discloses the periodic use of a set of configuration matrices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the cyclic configuration matrices of *Miles* into the system of *Uzun* by cyclically repeating the configuration matrices from one period of the system over multiple periods. The motive to combine is to reduce processing power by re-using the configuration matrices.

6. **Claims 19, 20, 21, 22, 23, 24, 25, 26, 27 and 29** are rejected under 35 U.S.C. 103(a) as being unpatentable over *Uzun*, et al. (US Patent No. 6,961,342 B1) in view of *Miles*, et al. (US Patent No. 6,665,495 B1) and *Reeve*, et al. (US Pre Grant Publication No. 2002/0027902).

Regarding claim 19, *Uzun* discloses:

a. A line card interface (Fig. 4, Element 450) device for carrying traffic having a statistical distribution which varies at a given variation rate, the interface device comprising a selector (Fig. 8, Element 410) and a control device, the selector having plural interface inputs (Fig. 8, Element 440) for connection to a first multi-path connection (Fig. 8, Element 440) plural interface outputs (Fig. 8, Element 460) for connection to a second multi-path connection, (Fig. 8, Element 460) and plural paths connecting the interface inputs to the interface outputs, (Fig. 8, Element 430) wherein the paths allow transfer of

more packets per unit time than are incident per unit time at the plural interface inputs, thereby providing speed-up (Column 32, Lines 36-39). (The system of *Uzun* discloses a switch that utilizes multiple input line card interfaces connected to multiple output line card interfaces sectors via several parallel interfaces and links and a central switch fabric [Fig. 8 and Column 12, Lines 44-64]. The line card interfaces each contain multiple virtual output queues into which the data received from each input in the sector is placed [Fig. 4 and Column 12, Lines 44-64]. Each input card interface has a selector that controls the connection of each VOQ to one of the multiple optical paths [Column 12, Line 65 to Column 13, Line 50]. Likewise each output line card interface receives multiple output paths that have been switched over the switch fabric and controls the connection of each Output Queue to connect it to the appropriate multi-path optical connection. [Column 13, Lines 50-65]. Finally, the system of *Uzun* provides for a speedup by increasing the number of multi-path connections such that the aggregate rate exceeds the aggregate rate of the input ports [Column 32, Lines 36-39].)

b. The selector further having a core switch to switch the multipath connections (Fig. 4, Element 430).

c. The control device having means for applying control signals to the switch control inputs at a rate corresponding to the rate of statistical variation in input traffic distribution (Column 14, Line 57 to Column 15, Line 5). (The system of *Uzun* implements Round Robin connection of each Virtual Output Group. This results in the cyclic connection of each VOQ to the corresponding Output Shared block. The round robin scheduling is capable of altering the cyclic pattern to allow an Output Group to Transmit Twice if

another output group is idle [Column 14, Line 57 to Column 15, Line 5]. Round robin Scheduling can be applied on a Per Group VOQ basis or a per output VOQ basis, depending on the type of Output queuing in use [Column 14, Line 5 to Column 15, Line 5].)

Uzun fails to disclose a line card interface device for carrying traffic having a statistical distribution which varies at a given variation rate, the interface device comprising an optical selector and a control device, the optical selector having plural interface inputs for connection to a first multi-path optical connection, plural interface outputs for connection to a second multi-path optical connection, and plural optical paths connecting the interface inputs to the interface outputs, wherein the optical paths allow transfer of more packets per unit time than are incident per unit time at the plural interface inputs, thereby providing speed-up, the optical selector further having plural optical switches, each said optical switch being operable to enable passage of optical data therethrough and to prevent passage of optical data therethrough according to control signals, the speed of response to the control signals being substantially less than said line rate, and the control device having means for applying control signals to the switch control inputs at a rate corresponding to the rate of statistical variation in input traffic distribution. In the same field of endeavor, *Miles* discloses a line card interface device for carrying traffic having a statistical distribution which varies at a given variation rate, the interface device comprising an optical selector and a control device, the optical selector having plural interface inputs for connection to a first multi-path optical connection, plural interface outputs for connection to a second multi-path optical connection, and plural optical paths connecting the interface inputs to the interface outputs, wherein the optical paths allow transfer of more packets per unit time than

are incident per unit time at the plural interface inputs, thereby providing speed-up, the optical selector further having plural optical switches, each said optical switch being operable to enable passage of optical data therethrough and to prevent passage of optical data therethrough according to control signals, the speed of response to the control signals being substantially less than said line rate, and the control device having means for applying control signals to the switch control inputs at a rate corresponding to the rate of statistical variation in input traffic distribution (Fig. 4 and 6). (The system of *Miles* discloses a cores switch that is comprised of a plurality of optical switches. The switch operates by closing all paths for a particular link except one, the desired output link [Fig. 6 and Column 9, Lines 34-57]. *Miles* further discloses the use of fiber optic transmitters to transmit data between two points.)

Therefore, since *Miles* discloses the use of an optical crossbar switch and optical connections, it would have been obvious to implement the optical crossbar and transmission of *Miles* into the teachings of *Uzun* by utilizing optical components to implement the connections of *Uzun* by implementing a separate optical crossbar link for each multipath optical connection and implementing the multipath optical connections between the core switch and the ingress and egress line cards using optical transmission, as taught by *Miles*. The motive to combine is to allow the use of optical transmission, thereby increasing bandwidth.

Uzun fails to disclose a line card interface device for carrying traffic defined by elements that specify the time-average capacity required between each traffic source - traffic sink pair the control device further having means for applying control signals to the switch control inputs at a rate in accordance with the statistical variations in the time-average capacity and not at a time slot rate corresponding to the rate of statistical variation in input traffic distribution. In the same field of endeavor, *Reeve* discloses a line card interface device for carrying traffic defined by elements that specify the time-average capacity required between each traffic source - traffic

sink pair the control device further having means for applying control signals to the switch control inputs at a rate in accordance with the statistical variations in the time-average capacity and not at a time slot rate corresponding to the rate of statistical variation in input traffic distribution (Paragraphs 0012-0021 and 0061-0095 and Figs 1, 3, and 4). (The system of *Reeve* discloses a system which maintains separate VOQ's at each ingress port [Fig. 1, Element 102]. The system of *Reeve* further discloses that the system schedules packet transmission in timeslots by creating a desired load matrix/rate matrix which may reflect the desired average traffic rate between each ingress [i.e. traffic source] and egress [i.e. traffic sink] queue [Paragraphs 0040 and 0074]. The rate matrix is then de-composed into a series of service matrices/configuration matrices which dictate the connection of the input and output ports for a particular timeslot and have rows and columns that add up to the total bandwidth on each of the internal links [Paragraphs 0060 to 0061]. The values contained in each rate matrix are integer values of 0 and 1 and are in units of the link rate, each corresponding to the transmission of a packet at the internal link rate for the timeslot. The system then implements the permutations to achieve the desired average bandwidth allocation between the source and sink ports [Paragraphs 0073-0095].)

Therefore, since *Reeves* discloses a system that assigns bandwidth by creating a series of connections between input and output ports at the timeslot rate such that the time average transmission rate over a series of the connections approaches the average rate specified for each traffic source/input and traffic sink/output pair, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the time averaged source sing connections of *Reeves* into the system of *Uzun* by connecting the data source/input and data sink/output ports according to a series of timeslot based connection patterns that approach the specified average transmission rate for each data source/data sink pair. The motive to combine

is to reduce scheduling complexity by considering scheduling only in a series of connection patters which result in the desired traffic transmission rates for each data source and data sink pair.

Uzun as modified by *Reeves* fails to disclose that the configured rates for each data source/data sink pair are stored in a matrix. However, it is officially noted that it was well known in the art at the time of the invention to use a matrix to store data in order to provide a simple construct for accessing related data elements. Therefore, it would have been obvious to a person of ordinary skill in the art at the time to arrange the average data rates for each data source/data sink pair in a matrix.

Regarding claim 20, *Uzun* discloses a line card interface wherein the paths are spatially distinct and are greater in number than the number of the plural interface inputs to provide spatial speed-up (Column 32, Lines 36-39). (The system of *Uzun* provides for a speedup by increasing the number of multi-path optical connections such that the aggregate rate exceeds the aggregate rate of the input ports [Column 32, Lines 36-39].)

Uzun fails to disclose a line card interface wherein the optical paths are spatially distinct and are greater in number than the number of the plural interface inputs to provide spatial speed-up. In the same field of endeavor, *Miles* discloses a line card interface wherein the optical paths are spatially distinct and are greater in number than the number of the plural interface inputs to provide spatial speed-up (Fig. 4 and 6). (The system of *Miles* discloses a cores switch that is comprised of a plurality of optical switches. The switch operates by closing all paths for a particular link except one, the desired output link [Fig. 6 and Column 9, Lines 34-57]. *Miles* further discloses the use of fiber optic transmitters to transmit data between two points.)

Therefore, since *Miles* discloses the use of an optical crossbar switch and optical connections, it would have been obvious to implement the optical crossbar and transmission of

Miles into the teachings of *Uzun* by utilizing optical components to implement the speed up connections of *Uzun* by implementing a separate optical crossbar link for each multipath optical connection and implementing the multipath optical connections between the core switch and the ingress and egress line cards using optical transmission, as taught by *Miles*. The motive to combine is to allow the use of optical transmission, thereby increasing bandwidth.

Regarding claim 21, *Uzun* discloses a line card interface according wherein the interface inputs and outputs are divided into input groups and output groups, each input group having a distributor, said distributor having one or more of said interface inputs and plural outputs, each output group having a multiplexer having an input, one or more interface outputs, (Column 12, Line 65 to Column 13, Line 50) and the paths comprise a connection wherein each input group is connectable to each output group (Column 13, Lines 50-65). (The system of *Uzun* discloses a line card interface wherein each virtual output queue forms an output group [Fig. 45, Element 412 and Column 12, Line 65 to Column 13, Line 50]. Each output group/VOQ is then distributed to the central switch fabric by a multiplexer, which takes each of the VOQs as an input and outputs each to one of its plural line outputs [Fig. 5, Elements jM to jM+M-1] at the appropriate time [Column 12, Line 65 to Column 13, Line 50]. Likewise, the input line card interfaces receive as an input the output from each of the multi-path connections, queues the results, and distributes the transmission of the queues over multiple switch outputs [Fig. 4 and Column 13, Lines 50-65].)

Uzun fails to disclose the use of optical paths to connect devices. In the same field of endeavor, *Miles* discloses the use of optical paths to connect devices (Fig. 4 and 6). (The system of *Miles* discloses a cores switch that is comprised of a plurality of optical switches. The switch operates by closing all paths for a particular link except one, the desired output link [Fig.

6 and Column 9, Lines 34-57]. *Miles* further discloses the use of fiber optic transmitters to transmit data between two points.)

Therefore, since *Miles* discloses the use of an optical crossbar switch and optical connections, it would have been obvious to implement the optical crossbar and transmission of *Miles* into the teachings of *Uzun* by utilizing optical components to implement the connections of *Uzun* by implementing a separate optical crossbar link for each multipath optical connection and implementing the multipath optical connections between the core switch and the ingress and egress line cards using optical transmission, as taught by *Miles*. The motive to combine is to allow the use of optical transmission, thereby increasing bandwidth.

Regarding claim 22, *Uzun* fails to disclose a line card interface according wherein the distributor and the multiplexer are electronic. However, it is officially noted that the use of electric distributors and multiplexers was well known in the art at the time of the invention. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement electrical distributors and multiplexers into the teachings of *Uzun* by using electronic circuits to perform the distribution and multiplexing functionality.

Regarding claim 23, *Uzun* fails to disclose a line card interface wherein the distributor and the multiplexer are optical. However, it is officially noted that the use of optical distributors and multiplexers was well known in the art at the time of the invention. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement electrical distributors and multiplexers into the teachings of *Uzun* by using optical circuits to perform the distribution and multiplexing functionality.

Regarding claim 24, *Uzun* discloses a line card interface wherein each input group has a respective input group memory, said distributor having plural outputs for writing to said input group memory and each output group has a respective output group memory, said multiplexer

input being connected to receive outputs from said output group memory (Figs. 4 and 5). (The output group of *Uzun* contains multiple VOQs which receive as in input each VOQ and give as an output one of multiple parallel outputs by the distributor [Fig. 5 and Column 12, Line 65 to Column 13, Line 50]. Likewise, the input line card interfaces form groups that receive as an input the output from each of the multi-path connections, queues the results in memory, and distributes the transmission of the queues over multiple switch outputs [Fig. 4 and Column 13, Lines 50-65].)

Regarding claim 25, *Uzun* fails to disclose a line card interface wherein the optical connection comprises an optical fibre device. In the same field of endeavor, *Miles* discloses a line card interface wherein the optical connection comprises an optical fibre device (Fig. 4 and 6). (The system of *Miles* discloses a cores switch that is comprised of a plurality of optical switches. The switch operates by closing all paths for a particular link except one, the desired output link [Fig. 6 and Column 9, Lines 34-57]. *Miles* further discloses the use of fiber optic transmitters to transmit data between two points.)

Therefore, since *Miles* discloses the use of an optical crossbar switch and optical connections, it would have been obvious to implement the optical crossbar and transmission of *Miles* into the teachings of *Uzun* by utilizing optical components to implement the connections of *Uzun* by implementing a separate optical crossbar link for each multipath optical connection and implementing the multipath optical connections between the core switch and the ingress and egress line cards using optical transmission, as taught by *Miles*. The motive to combine is to allow the use of optical transmission, thereby increasing bandwidth.

Regarding claim 26, *Uzun* fails to disclose a line card interface wherein the optical connection comprises optical components providing free-space paths in use. In the same field of endeavor, *Miles* discloses a line card interface wherein the optical connection comprises

optical components providing free-space paths in use (Fig. 4 and 6). (The system of *Miles* discloses a cores switch that is comprised of a plurality of optical switches. The switch operates by closing all paths for a particular link except one, the desired output link [Fig. 6 and Column 9, Lines 34-57]. *Miles* further discloses the use of fiber optic transmitters to transmit data between two points.)

Therefore, since *Miles* discloses the use of an optical crossbar switch and optical connections, it would have been obvious to implement the optical crossbar and transmission of *Miles* into the teachings of *Uzun* by utilizing optical components to implement the connections of *Uzun* by implementing a separate optical crossbar link for each multipath optical connection and implementing the multipath optical connections between the core switch and the ingress and egress line cards using optical transmission, as taught by *Miles*. The motive to combine is to allow the use of optical transmission, thereby increasing bandwidth.

Regarding claim 27, *Uzun* discloses a line card interface wherein each input group has the same number of inputs as the number of outputs of said output groups (Fig. 5, VOQ). (The system of *Uzun* may comprise one VOQ for each output port [Fig. 5, VOQ].)

Regarding claim 29, *Uzun* fails to disclose a line card interface having latching circuitry for storing packet data for input to said interface inputs whereby said multi-path optical connections have a line rate reduced compared to said line rate. In the same field of endeavor, *Miles* discloses a line card interface having latching circuitry for storing packet data for input to said interface inputs whereby said multi-path optical connections have a line rate reduced compared to said line rate (Figs 21 and Fig. 13, Element 138). (The system of *Miles* discloses that the core switch module transmits and receives data via multiple parallel streams destined for the same output transmitted simultaneously via dense wavelength division multiplexing [Figs. 14 and 15 and Column 21, Lines 36-60]. The system further discloses that in one embodiment,

a petabit router is constructed [Figs. 19, 20 and 21]. In this embodiment, multiple parallel transmission paths are used to satisfy the bandwidth requirements of the system, transmitting multiple bundles of multiple sets of DWDM multiplexed data transmitted at 40Gbps for each channel [Column 26, Lines 16-46]. The input bandwidth of a port in this embodiment is 16 Terabit/13 Input Ports [See Fig. 20]. Therefore, each 40Gbps channel is significantly smaller than the input bandwidth. Finally, it is inherent that the system of *Miles* has latching circuitry in the receiving DWDM de-multiplexer, as the signal could not be received without synchronizing the receiver.)

Therefore, since *Miles* discloses decomposing a high speed input port into multiple DWDM multiplexed signals at the core router, it would have been obvious to a person of ordinary skill to implement the DWDM de-multiplexing and of *Miles* into the teachings of *Uzun* by de-composing each of the links to the core switch module into multiple parallel DWDM low speed links and transmitting the parallel low speed links in parallel across the core switch. The motive to combine is to reduce hardware costs and memory bandwidth requirements by using lower speed links in parallel.

7. **Claim 28** is rejected under 35 U.S.C. 103(a) as being unpatentable over *Uzun*, et al. (US Patent No. 6,961,342 B1), *Miles*, et al. (US Patent No. 6,665,495 B1) and *Reeve*, et al. (US Pre Grant Publication No. 2002/0027902) as applied to claim 21 and further in view of *Carvey*, et al. (US Patent No. 6,934,471 B1).

Regarding claim 28, *Uzun* fails to disclose a line card interface wherein each memory is a dual-port memory having an input port for writing to the memory and an output port for reading from the memory. In the same field of endeavor, *Carvey* discloses a line card interface wherein

each memory is a dual-port memory having an input port for writing to the memory and an output port for reading from the memory (Column 4, Lines 43-56). (The system of *Carvey* discloses the use of dual ported memory to enable simultaneous writing and reading to the same memory unit.)

Therefore, since *Carvey* discloses the use of dual ported memory, it would have been obvious to a person of ordinary skill in the art at the time of the invention to implement the dual ported memory of *Carvey* into the teachings of *Uzun* by implementing dual ported memory for the buffers of *Uzun*. The motive to combine is to increase speed by allowing simultaneous write and read access to memory.

Response to Arguments

8. Applicant's arguments filed, 4 August 2009, have been fully considered but they are not persuasive.

Applicant's arguments that *Uzun* fails to disclose "a packet switch for switching packets, carried in time slots, between traffic sources and traffic sinks, ... to allow transfer of packets according to a matrix with elements that specify the time-average required capacity between each traffic source - traffic sink pair wherein the set of links is varied in accordance with variations in the time-average capacity and not at a time slot rate.", as required by independent claim 1 and analogous claims 4, 12 and 19, have been considered and are not persuasive. In response to the applicant's amendments, the recited elements have now been identified in the previously recited reference, *Reeve*, et al. (See the rejection of claim 1, *Supra*).

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher Crutchfield whose telephone number is (571) 270-3989. The examiner can normally be reached on Monday through Friday 8:00 AM to 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Daniel Ryman can be reached on (571) 272-3152. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Christopher Crutchfield/
Examiner, Art Unit 2466
12/3/2009

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